Name: KEY Block: ______

Heating Curves

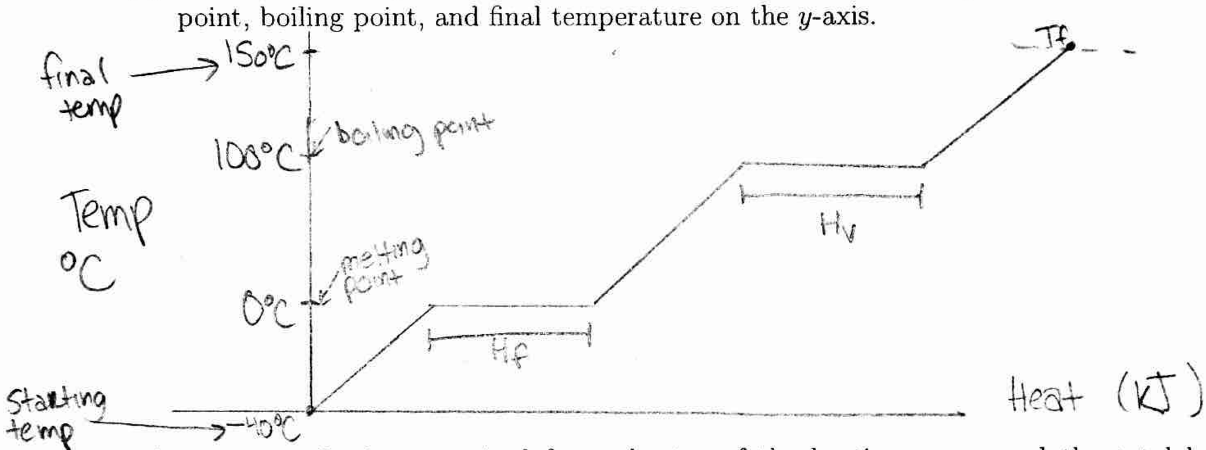
Use data from the following table:

Compound	C (*sol.*) ($\frac{kJ}{kg \cdot °C}$)	M.P. (°C)	ΔH_{fus} ($\frac{kJ}{kg}$)	C (*liq.*) ($\frac{kJ}{kg \cdot °C}$)	B.P. (°C)	ΔH_{vap} ($\frac{kJ}{kg}$)	C_p (*gas*) ($\frac{kJ}{kg \cdot °C}$)
H_2O	2.11	0	334	4.181	100	2260	2.08*
K	0.560	62	61.4	1.070	760	2025	0.671
Hg	0.142	−39	11.3	0.140	357	293	0.104
Ag	0.217	962	111	0.318	2212	2360	—

Note that because of the volume change from heating, the specific heat capacity of gases, C_p, increases with increasing temperature.

1. A 0.0250 kg sample of H_2O is heated from −40.0°C to 150.°C.

   (a) Sketch the heating curve for the above process. Label the starting temperature, melting point, boiling point, and final temperature on the y-axis.



   (b) Calculate the heat required for each step of the heating curve, and the total heat required.

80.01 kJ

−40°C → 0°C: $Q = mc\Delta T = (.025)(2.11\frac{kJ}{kg°C})(40) = 2.11\ kJ$

s → l: $Q = mH_f = (.025)(334\frac{kJ}{kg}) = 8.35\ kJ$

0°C → 100°C: $Q = mc\Delta T = (.025)(4.181)(100) = 10.45\ kJ$

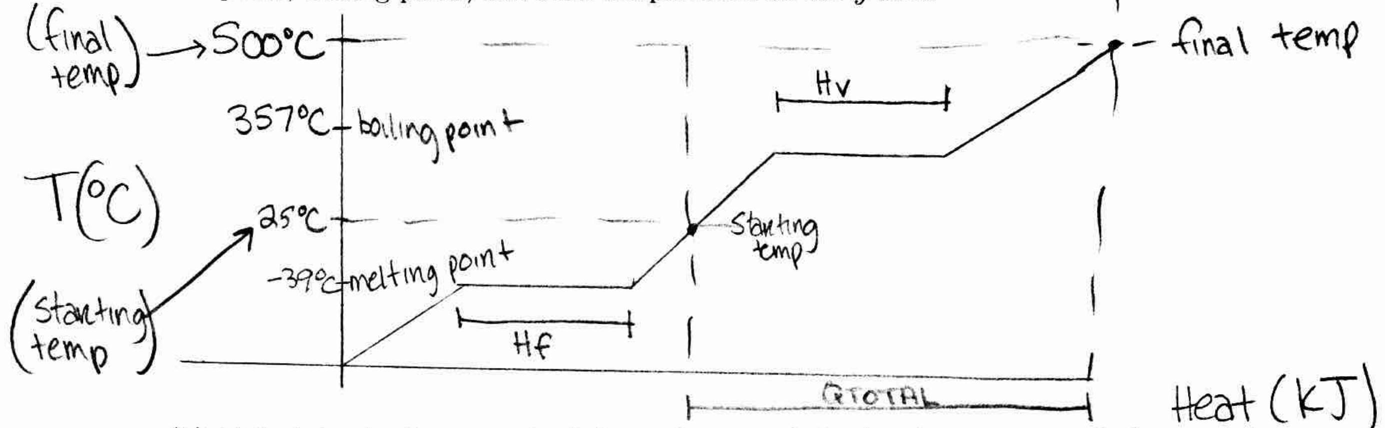
l → g: $Q = mH_v = (.025)(2260) = 56.5\ kJ$

100°C → 150°C: $Q = mc\Delta T = (.025)(2.08)(50) = 2.6\ kJ$

$Q_{TOTAL} = 80.01\ kJ$

2. A 0.085 kg sample of mercury is heated from 25°C to 500°C.

   (a) Sketch the heating curve for the above process. Label the starting temperature, melting point, boiling point, and final temperature on the y-axis.



   (b) Calculate the heat required for each step of the heating curve, and the total heat required.

30.12 kJ

25°C → 357°C
$Q = mc\Delta T$
$= (0.085)(0.140 \frac{kJ}{kg°C})(332°C)$
$= 3.95\ kJ$

l → g
$Q = mH_v$
$Q = (0.085)(293 \frac{kJ}{kg})$
$= 24.9\ kJ$

357°C → 500°C
$Q = mc\Delta T$
$= (0.085)(0.104 \frac{kJ}{kg°C})(143°C)$
$= 1.26\ kJ$

$Q_{TOTAL} = 30.1\ kJ$

K

3. An 0.045 kg block of silver at a temperature of 22°C is heated with 20.0 kJ of energy. Calculate the total heat required by calculating the heat for each step until the entire 20.0 kJ is accounted for.

   What is the final temperature and what is the physical state (solid, liquid, gas) of the silver at that temperature?

liquid

1 369°C

solid at 22°C

22°C → 962°C
$Q = mc\Delta T$
$= (0.045\ kg)(0.217 \frac{kJ}{kg°C})(962-22)$
$= 9.18\ kJ$

s → l
$Q = mH_f$
$= (0.045)(111 \frac{kJ}{kg})$
$= 4.995\ kJ$

20 kJ − 9.18 − 4.995
= 5.825 kJ left

962°C → ?
$Q = mc\Delta T$
$5.825\ kJ = (0.045\ kg)(0.318 \frac{kJ}{kg°C})\Delta T$
$\Delta T = 407.06$

962°C + 407°C
$T_f = 1369°C$ liquid